VS-30(M) SWEEP GENERATOR

OPERATING AND INSTRUCTION MANUAL

Texscan

CERTIFICATION

Texscan Corporation certifies that this instrument has been thoroughly tested, inspected, and found to be in compliance with its published specifications.

Ours is (VS 30 #436) with 1, 10 – 50 Harmonic Markers.

OPERATING AND INSTRUCTION MANUAL

Markers $28 each

MODEL VS-30(M)

SWEEP GENERATOR

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ADDENDUM

VS-30(M)

August 19, 1966

Circuit reference Q8 changed from Texscan part number 062-006, transistor, 2N3054, to Texscan part number 062-021, transistor, 2N3738.

August 26, 1966

Circuit references R356, R357, and R700 have been changed from Texscan part number 045-672 to 470 ohm, ½W, ± 10% resistors, Texscan part number 045-696.

L705, Texscan part number 035-002, has been replaced by C711, 2.4pf capacitor, Texscan part number 012-090.

September 22, 1966

Circuit reference P402 changed from Texscan part number 020-011 to Texscan part number 020-026, connector, plug, Star 8002.

Circuit reference R14 changed from Texscan part number 046-180 to Texscan part number 046-480, resistor, fixed, 47Kohm, 1W, ± 10%, on parts list only.

On figure 6-2, circuit reference R504 is a 220 ohm, ½W, ± 10% resistor.

September 23, 1966

The following specifications have been changed:

	WAS	CHANGED TO
FREQUENCY RANGE	100 kHz to 100 MHz	300 kHz to 100 MHz
RF VERNIER	0 to 6 db	0 to 3 db

These changes should be noted on the specification page as well as wherever referred to in other sections. Special care should be taken in the calibration section to be certain the unit is adjusted for the correct specification.

December 2, 1966

The sweep width specification has been changed from 100 kHz-100 MHz to typically 100 kHz-100 MHz.

ADDENDUM

VS-30(M)

Page Two

January 5, 1967

Circuit reference number C427 changed from Texscan part number 012-125 to Texscan part number 012-134, capacitor, fixed, 0.05uf, 50V, Sprague TGS50.

Circuit reference Q405 changed from a factory selected value to Texscan part number 062-016, transistor, 2N3866, Vector 2N3866

Circuit reference number P402 is deleted.

Circuit reference number R432 is deleted.

Circuit reference Z402 is added, feed-thru termination, Texscan part number A204-155.

March 6, 1967

Page 2-5

Lines three and four should read "frequency range of 375 MHz to 425 MHz."

Line two - paragraph 2 should read "frequency range of 375 MHz to 325 MHz."

Page 6-2 - Figure 6-2

960 to 810 MHz should read 375 MHz to 425 MHz

660 to 810 MHz should read 375 MHz to 325 MHz

March 8, 1967

Page 6-3, 6-3

Has a heading which describes the video amplifier as a 0.5 - 300 MHz video amplifier. This should read 0.1 to 100 MHz.

April 7, 1967

In figure 6-5, page 6-5 a +30 volt supply voltage should be shown at the junction of R327 and R336.

ADDENDUM

VS-30(M)

PAGE THREE

June 2, 1967

Circuit reference number R122 changed from Factory Selected Value to Texscan part number 045-728, Resistor, Fixed, 2.7K, ½W, 10%.

Circuit reference number R15 changed from Texscan part number 046-052 to Texscan part number 046-463, Resistor, fixed, 18K ohm, 1W, 10%.

Circuit reference numbers, CR7, CR8, CR9, CR101, CR102, CR103, CR104 and CR451 changed from 1N461A to 1N457A.

Circuit reference numbers Q451 and Q452 changed from 2N3638A to 2N3644.

SECTION 1

SPECIFICATIONS

1.1	FREQUENCY RANGE	100 kHz to 100 MHz. The unit can be centered at any frequency between 100 kHz and 100 MHz and sweep within that range.
1.2	RF OUTPUT	The RF output is at least 1.0v rms into a 50-ohm load.
1.3	SWEEP WIDTH	The sweep width is continuously variable from 100 kHz to 100 MHz at any center frequency, but the unit will not sweep above 100 MHz at rated output. The unit is also provided with a CW output mode for signal generator applications.
1.4	DISPLAY LINEARITY	The linearity of output frequency versus time is better than 1.2 to 1 at maximum sweep width and is typically better than 1.1:1 at narrow sweep widths.
1.5	ATTENUATION	The unit has a 0 to 6 db vernier control of RF output and a rocker switch attenuator which provides 0 to 102 db attenuation in 1 db steps.
1.6	FLATNESS	The flatness is better than $\pm$ 0.25 db at maximum sweep width. As sweep width is narrowed, flatness improves (typical readings at 10% sweep width are $\pm$ 0.1 db or better).
1.7	SWEEP RATE	Four sweep rate modes are provided: (1) variable from 5 Hz to 60 Hz, (2) 50/60 Hz line rate, (3) manual sweep, and (4) external.
1.8	HORIZONTAL DRIVE	A triangular waveform of at least 10 volts peak to peak is provided for oscilloscope horizontal drive.
1.9	MONITOR	Both internal and external monitor functions are provided. The flatness specifications apply to the internally monitored unit.
1.10	MARKERS	The unit has a birdy-by-pass marker system with provision for up to eight single frequency or harmonic markers. An external marker input is provided which can be used with a CW source to produce a variable marker.

1.11 POWER CONSUMPTION	Approximately 15 watts, 50/60 Hz, 115/230 volts
1.12 SIZE	6-7/8" x 17" x 16"
1.13 WEIGHT	Approximately 21 lbs.

SECTION 2

GENERAL DESCRIPTION

2.1 GENERAL INFORMATION

The VS-30 sweep generator is a solid state instrument that provides wide frequency coverage, variable sweep rate, external marker capability, and complete control of the RF output level. This unit has provisions for accepting up to eight single frequency or harmonic plug-in markers for frequency identification. A birdy-by-pass marker system is used, providing accurate marker placement. The VS-30 has many additional features including manual sweep and external leveling.

The transistors used are all silicon, and the low frequency circuits are assembled on high quality printed circuit boards for maximum reliability and serviceability.

The VS-30 covers the frequency range of 100 kHz to 100 MHz. A block diagram of the sweep system is shown in figure 2-1. The output frequency of 0.1 to 100 MHz is derived by taking the low level heterodyne output of two oscillators and amplifying this output to 1.0v rms. Low level mixing is employed to maintain a low spurious output signal. As can be seen in figure 2-1, the RF output is sampled and detected in the monitor block. This sample is amplified in the leveler circuitry, compared to a stable reference voltage, and the error voltage used to automatically alter the leveled B+ to the video amplifier to compensate for RF output level changes. This electronic servo system provides automatic leveling which maintains the sweep output flat to within $\pm$ 0.25 db.

This same monitor system provides a sample of the RF signal for use in the birdy-by-pass marker system. Markers are obtained by mixing the sweep sample with a CW source and amplifying a narrow band of frequencies around the resultant zero beat. These markers can be conveniently added to the detected output of the unit being tested by using the adder provided in the unit.

The VS-30 is provided with a wide range of output attenuation capability--an RF vernier attenuator with 6 db range and a 1 db step attenuator providing up to 108 db of continuously variable output attenuation.

The variable sweep rate is possible because the unit is electronically swept with a varactor used as the voltage sensitive element of the sweep oscillator. The drive for the varactor is derived from a sawtooth generator and nonlinear shaping circuit. The sawtooth is distorted to compensate for the nonlinear voltage versus capacitance characteristic of the varactor, thereby providing a linear frequency change with time.

2.2 INTRODUCTION

The block diagram of the VS-30, shown in figure 2-1, can be divided into five major sections: (1) the sweep drive and blanking circuits, (2) the sweep oscillators and mixer, (3) video amplifier and leveler circuitry, (4) power supply, and (5) marker circuitry. The following paragraphs present a description of the circuit details of each of these sections.

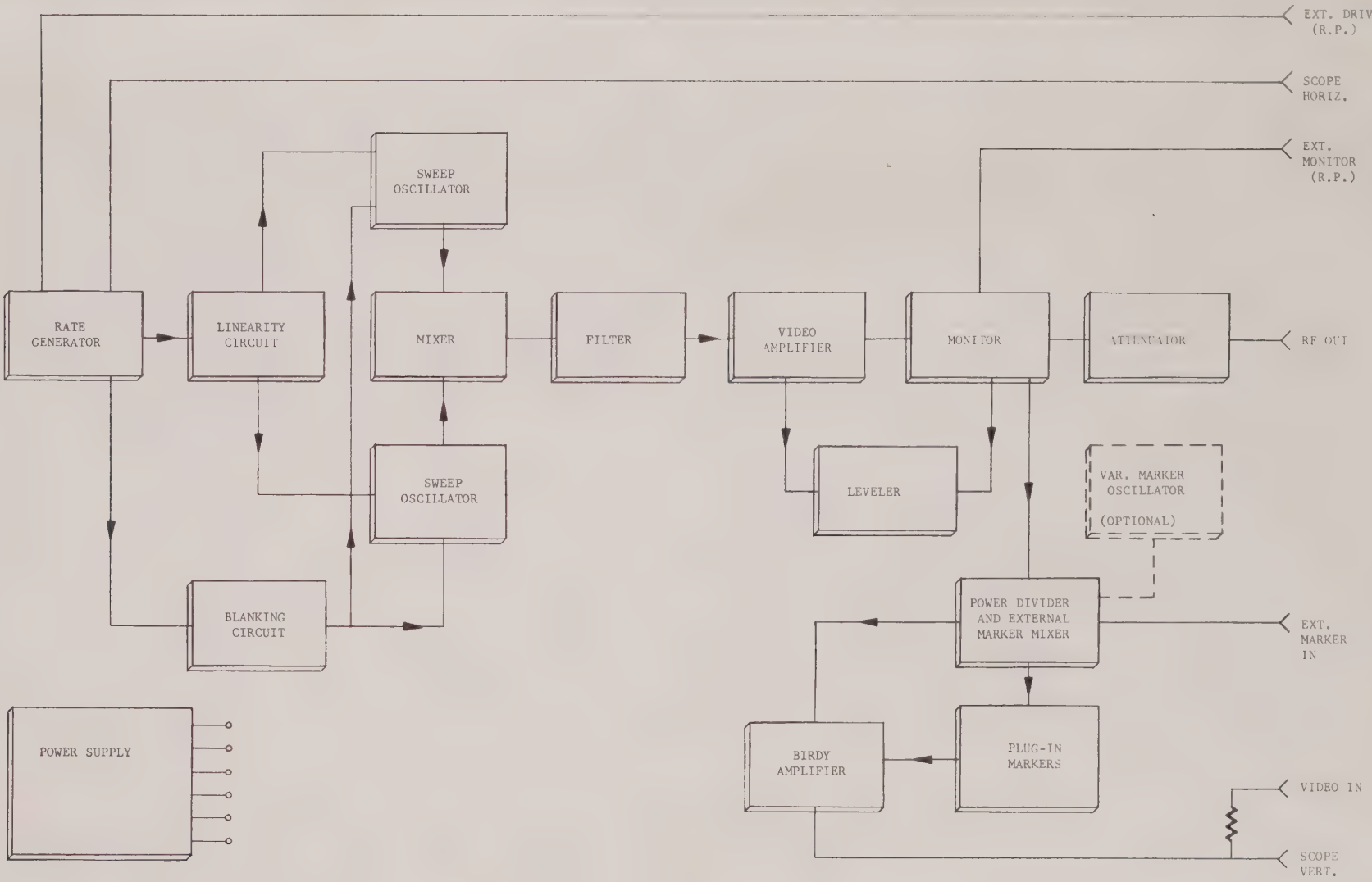


FIGURE 2-2

1161
VS-40

2.3 SWEEP DRIVE AND BLANKING CIRCUITS

The sweep drive and blanking circuit schematic is shown in figure 6-1. This circuitry provides a properly phased and distorted sweep drive signal for the varactors in each sweep oscillator. It also provides the B+ to the sweep oscillators which is blanked off during the sweep oscillator retrace time. Figure 6-1 is most easily understood by discussing the rate generator and then the linearity circuit.

2.3.1 Rate Generator

This circuit has four modes of operation corresponding to the four sweep rate modes provided with the VS-30. The four modes are achieved by changing the operating characteristics of the basic rate generator consisting of a Schmidt Trigger and Miller Integrator.

Transistors Q101 and Q102 are incorporated in the Schmidt Trigger, and Q103 and Q104 are used in the Miller Integrator. This combination of a Schmidt Trigger and Miller Integrator provides square wave and triangular wave outputs with a fixed phase relationship. The square wave is present at the collector of Q102; the triangular wave, at the collector of Q104. The circuit provides these signals with constant amplitude over the frequency range of the rate generator.

The time constant of C102 and R118A is adjusted by varying R118A, the sweep rate vernier front panel control, thereby changing the sweep rate. At special request, C102 can be provided for different sweep rate ranges. In the standard VS-30, C102 and R118A have values which provide a rate variable from 5 to 60 Hz.

The square wave at the collector of Q102 is amplified by a common emitter and emitter follower pair to provide the B+ voltage to the RF oscillators. These amplifier stages employ transistors Q108 and Q109. The blanked B+ is taken at the emitter of Q109. Being properly phased with the sweep drive, this signal turns off the sweep oscillators during their retrace time. That is, the triangular wave sweeps the oscillators in one direction with its positive slope, and in the opposite direction with its negative slope. The blanked B+ is phased properly to turn off the sweep oscillator during the negative slope portion of the sweep drive.

The triangular wave at Q104's collector is coupled to the linearity circuit. In the variable sweep rate mode this circuit is free running, and, as pointed out previously, R118A, a front panel adjustment, can be varied to change the sweep rate.

The sweep rate selector switch, S100 (the five-pole sweep rate function switch), converts this basic rate generator to the other three modes of operation.

In the line rate position, a 60 Hz signal from the power transformer is coupled through C101 to the base of Q101. This signal locks the generator to the line frequency. The other poles of the switch convert the circuit time constants, etc., to insure the locking and provide the same amplitude signal as in the free-running mode.

In the manual sweep rate mode of operation, S100 bypasses the rate circuit and provides a DC voltage at the rate generator output. R118B provides adjustment of this output voltage through the same amplitude swing normally available from the rate generator.

The last switch position, the external sweep rate position, also bypasses the rate circuit and allows the unit to be swept from an external source.

2.3.2 Linearity Circuit

An emitter follower, using Q105, is the coupling stage between the rate generator and the linearity circuit. The emitter follower output of the rate generator is coupled through a sweep width switch and potentiometer combination consisting of S101, R129, and R133. This switch and potentiometer combination is used to adjust the amplitude of the triangular wave (or more correctly, the amplitude swing of the drive voltage) in two different ranges. This signal is amplified and phase split in the transistor stages, Q106 and Q107. The signals at the collectors of Q106 and Q107 are approximately equal in amplitude and 180° out of phase.

The diode break circuitry, consisting of CR101, CR102, CR103, CR104, R142, R143, R144, R145, R147, R151, R152, R153, and R154 distorts the drive signals at the collectors of these two transistors. This circuit is piece-wise linear. For example, for any assumed combination of forward and back biased diodes, the circuit has a linear characteristic. As the voltages at the collectors of these two transistors increase, sequentially each of these diodes conduct and the resultant waveform is distorted. The shape of this waveform can be adjusted with the potentiometers included in the circuit. These two, 180° out of phase, distorted, drive voltages are coupled to the varactors in the two sweep oscillators. R159, R161, and R164 are potentiometer controls for setting the DC level of the sweep drive voltages. R161 is the front panel center frequency adjustment. The undistorted signal at the emitter of Q105 is also coupled to the front panel to provide the horizontal axis oscilloscope drive voltage.

In summary, the circuitry shown in figure 6-1 supplies blanked B+ to the sweep oscillators, horizontal oscilloscope drive, and sweeping voltages for the sweep oscillators. It includes a sweep rate function switch, a vernier control, a center frequency control, and a sweep width control.

2.4 SWEEP OSCILLATORS AND MIXER

The two sweep oscillators, mixer, and low-pass filter are shown in figure 6-2.

The two sweep oscillators have essentially the same characteristics, each being a tuned line varactor swept oscillator. One oscillator, using transistors Q501 and Q502, sweeps through the frequency range of 300 MHz to 350 MHz The sweep drive voltage for this oscillator is coupled to the varactor, CR502, which changes the electronic length of the tuned line, thereby changing the oscillator's output frequency.

The second sweep oscillator, using transistors Q503 and Q504, sweeps within the range of 300 MHz to 250 MHz. The varactor in this circuit is CR504. The outputs of these two sweep oscillators are coupled to the mixer diode, CR503, and the lower sideband output from this mixer is filtered in the low-pass filter, Z501, and delivered to the video amplifier. As the one oscillator is sweeping down in frequency, the other is sweeping up; consequently, the resultant output sweep width is twice as great as that provided by either oscillator.

Center frequency is controlled by varying the DC level of the sweep drive to each oscillator, while sweep width is changed by varying the amplitude of the distorted drive signal. The outputs of the two sweep oscillators are very loosely coupled to CR503 so that the mixing is accomplished at extremely low signal levels within the square law region of the mixing diode. This results in a very low spurious output signal.

2.5 VIDEO AMPLIFIER AND LEVELER

The circuitry, shown in figure 6-3, consists of a video amplifier, monitor, leveler, and an output attenuator. The video amplifier amplifies the output from the low-pass filter described above.

This video amplifier has a relatively flat frequency response from 100 kHz to 100 MHz. It consists of three gain stages, each stage including a common emitter amplifier transistor and an emitter follower transistor. The three stages are essentially identical. Within each stage feedback is employed to stabilize gain. For example, in the input stage C406, R406 and R407 provide local feedback. Neutralization is also included in each couplet. For example, C405 in the input stage adjusts the phase of the feedback in the emitter of Q401.

The output of the video amplifier at the emitter of Q406 is coupled through a rocker switch attenuator to the front panel. This output is sampled and detected with the monitor diode, CR401--filtered by R433, C425, and C426--amplified in the differential amplifier consisting of Q451 and Q452--and further amplified in the common emitter stage, Q453, and emitter follower, Q454.

This DC voltage, which varies with RF output level, is provided as the B+ to the first two stages of the video amplifier, and it is properly phased through these amplifier stages to increase B+ voltage when the detected RF output decreases.

This closed loop system compensates for RF output changes and provides an electronically leveled, flat RF signal at the point monitored by CR401. Because the leveler is maintaining a constant RF output voltage at the monitor point, this point is a zero impedance constant voltage point. R432, consequently, creates the source impedance for the sweep generator.

CR451, in the base of Q454, prevents back biasing of the video amplifier transistors and damage to them in the event of a component failure in the leveler.

Included within the unit is a switch, S451, which bypasses the internal monitor and connects the leveler circuit to a front panel external monitor input connector. This allows the unit to be leveled at some remote location if the user provides a detected monitor signal from that leveling point.

A sample of the RF output for use in the marker circuitry is coupled from the emitter of Q406. This sample of the swept signal is necessary for production of markers in the birdy-by-pass system.

2.6 POWER SUPPLY

The DC power supply for this unit is shown in figure 6-4. This circuit provides--regulated +7v, +30v, +110v, and -30v--and an unregulated +50v. The input transformer, T1, is designed so that the unit can be wired for either 115v or 230v input voltages. The units are normally shipped wired for 115v. To change from 115v to 230v operation, examine figure 2-2.

All the power supply voltages are derived from three full wave rectifiers. One full wave rectifier, consisting of CR1 and CR2, is filtered with C1A, C1B, and R15, and coupled through the pass transistor, Q8. This is the +110v regulated output. The voltage across the pass transistor is electronically varied to compensate for line voltage and load impedance changes. Any change in output voltage is sensed by the voltage divider consisting of R18, R19, and R20, compared to the reference Zener, D6, then differentially amplified in Q10 and the emitter follower, Q9; thereby changing the current through the base of the pass transistor, Q8, in the proper phase to compensate for this output voltage change. This well-regulated DC voltage typically has an output ripple of 3 mv and maintains its regulation through a 10% line voltage change.

The +30v supply is fed from the full wave rectifier consisting of CR5 and CR6. This circuit is similar to the circuit used in the +110v supply except the resistor values and Zener voltages differ; and an additional transistor stage, Q3, is added for preregulation. This supply typically has a ripple, at the output, of 6 mv.

The -30v supply is fed from the fullwave rectifier consisting of CR3 and CR4 and fed through pass transistor, Q5. This regulator circuit is essentially

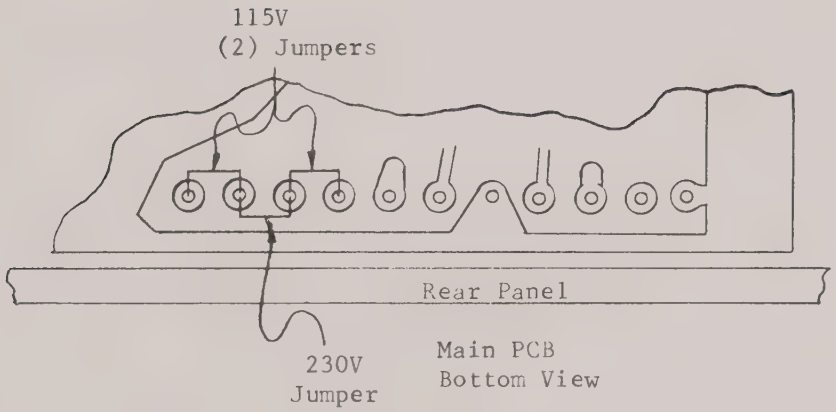


Figure 2-2
115V, 230V Hookup

the dual of the +110v supply with the transistor hookup varied to achieve a negative output voltage. Some additional filtering of Zener noise through C8 was added to this circuit. This regulated -30v typically has a ripple of 4 mv.

The +50v output is taken from the input of the +30v regulator and filtered with R1 and C1D.

2.7 MARKER CIRCUITRY

The unit is supplied with a birdy-by-pass marker system, figure 6-5, which has an external marker input plus provision for eight plug-in single frequency (SM) or harmonic (HM) markers. In the marker system a sample of the swept RF signal is mixed with the fundamental or a harmonic of the plug-in markers to produce beatnotes or birdies. These beatnotes or birdies are then amplified, shaped, and superimposed upon the demodulated video signal and applied to the vertical channel of the oscilloscope.

The sweep sample from the video amplifier output is divided to provide two coupled signals to the marker circuitry. When an external CW source is being used as a marker, the signal is fed into a diode mixer, CR351, where it is mixed with the sweep sample from R355. The signal is then fed to the external marker amplifier, Q306, which is a high gain common emitter amplifier.

R331 is a front panel, external marker size control which allows the external marker system to accept a wide variation in signal source amplitudes.

The plug-in marker system is seen to consist of eight plug-in receptacles. Each plug-in receptacle has its own internal size adjustment. The markers produced in each plug-in can be independently controlled in amplitude with potentiometers R305, R306, R311, R312, R317, R318, R324, and R325. This allows each marker to be adjusted to a different amplitude and gives quick and easy identification of the various markers on the oscilloscope display.

There are four amplifier stages built on the plug-in marker printed circuit board. Each amplifier stage is being fed from two plug-in marker receptacles. The outputs of all four amplifier stages are fed through a common emitter amplifier, Q305. This plug-in marker signal and the external marker signal from Q306 are coupled to a common birdy amplifier stage which includes the marker shaper circuit consisting of C307, C308, C309, C310, C311, L301, R334, and R335. This shaped marker is further amplified in Q307.

After amplification, the markers are applied to the marker size potentiometer, R339, which is a front panel adjustment, and become available at the oscilloscope vertical output connector on the front panel.

SECTION 3

OPERATING INSTRUCTIONS

3.1 INTRODUCTION

The VS-30 is a versatile, wide range sweep generator which incorporates the latest sweep techniques. It can be employed as a CW source as well as a sweep generator. Most of its operating features can be easily understood from a description of the front panel controls. This unit is supplied for operation from a 115 volt, 50/60 Hz power source but can be supplied for 230 volt operation.

3.2 DESCRIPTION OF FRONT PANEL CONTROLS AND CONNECTORS

A drawing of the front panel of the VS-30 is shown in figure 3-1. An identification of each control and its function is as follows:

3.2.1 Center Frequency Dial

Indicates the frequency of the output in the CW modes and at minimum sweep width in the sweep modes.

3.2.2 Power Switch

Switches on the line voltage to the unit.

3.2.3 Ext. Marker Size Control

Provides adjustment of the amplitude of the external marker, if used.

3.2.4 Fixed Marker Size and Shaper

This dual control varies the size of all birdy markers, both plug-in SM or HM markers and external markers. The shaper can be used to vary the bandpass of the birdy amplifier and, subsequently, narrow or widen the birdy marker width.

3.2.5 Monitor Switch and RF Vernier

The monitor switch can be used to switch from normal operation to external leveling. When in the EXT position, the RF level set potentiometers must be adjusted and an external monitor signal must be provided or the unit will not meet its flatness specifications. The RF VERNIER provides continuously variable adjustment of the RF output level over a 6 db range.

3.2.6 Attenuation

The rocker switch attenuator can be used to control the amplitude of the RF output by as much as 102 db in 1 db increments.

3.2.7 Sweep Width Control

This potentiometer and switch combination is used to vary the sweep width of the output and to select the CW mode of operation.

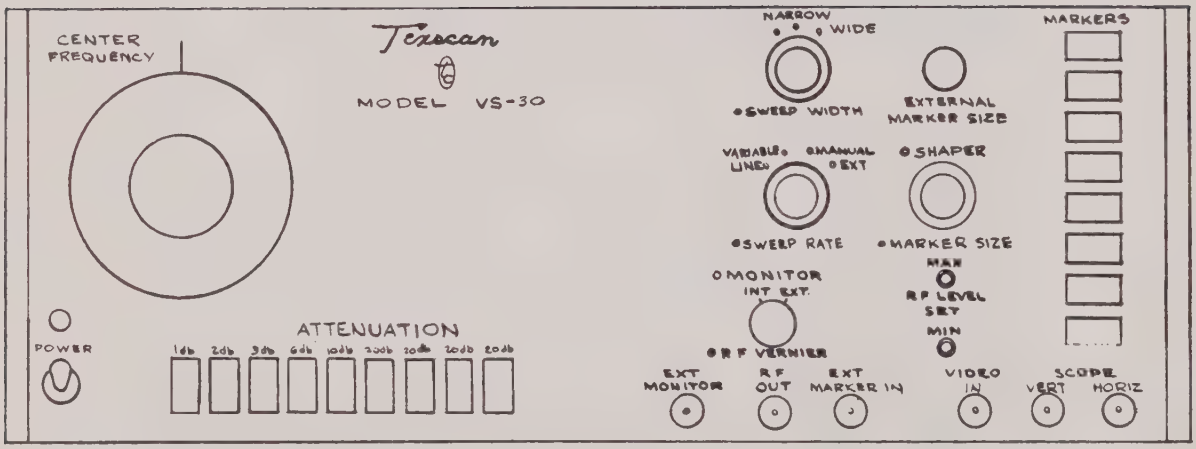


FIGURE 3-1

FRONT PANEL CONTROLS AND TERMINATIONS

3.2.8 Sweep Rate Control

This potentiometer and switch combination provides control of the rate at which the RF output is swept. Four modes are provided: (1) Line--50/60 Hz sweep rate, (2) Variable--5 to 60 Hz continuously variable, (3) Manual--center knob can be used to manually sweep the unit, (4) External--external source may be employed to sweep the RF oscillator.

3.2.9 Marker Switches

These switches are used to turn on or off any plug-in markers employed.

3.2.10 RF Out Connector

Connector for swept or CW output.

3.2.11 Ext. Marker Connector

This connector allows an external signal source to be inserted to provide a marker on the video output.

3.2.12 Video In Connector

The detected RF from the device under test is inserted here to superimpose birdy markers on the detected signal.

3.2.13 Scope Vertical

The detected RF signal with markers superimposed is available at this connector for connection to the oscilloscope vertical channel.

3.2.14 Scope Horizontal

The oscilloscope horizontal drive signal is available at this connector.

3.2.15 RF Level Set Potentiometers

Two potentiometers are provided on the front panel to set the maximum and minimum output power levels which can be obtained by varying the RF VERNIER Control. These potentiometers are set at the factory for proper operation with the internal monitor system. They are provided as front panel controls so that if an external monitor is employed, these levels can be reset.

3.2.16 Ext. Monitor Connector

The monitor signal from an external monitor, if used, is inserted here.

3.3 DESCRIPTION OF REAR PANEL CONTROLS

3.3.1 External Drive

A sweep drive signal from an external source may be inserted here.

3.4 TYPICAL TEST SETUP

For a typical test application make connection to the oscilloscope, device under test, detector, and sweep generator as shown in figure 3-2.

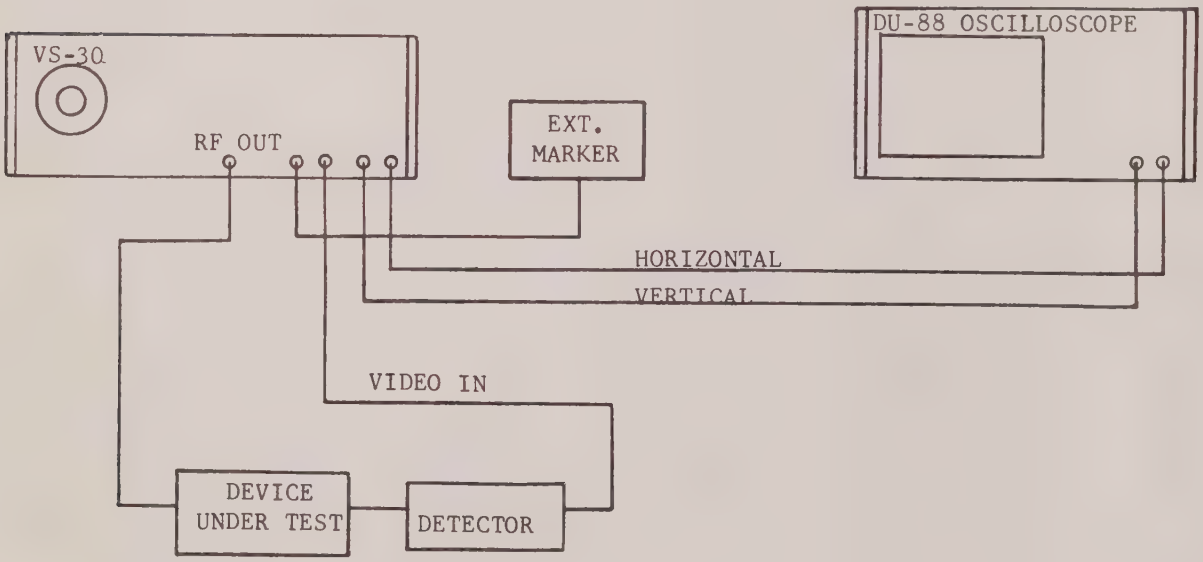


Figure 3-2

TYPICAL TEST SETUP

This is the setup for measurement of bandpass characteristics and is the most widely used application for sweep generators.

SECTION 4

ADJUSTMENT PROCEDURE

4.1 INTRODUCTION

The adjustments and test of this instrument can be accomplished with the following auxiliary test equipment--an oscilloscope (such as HP-130C), a VTVM, and a multimeter. It is suggested that the reader familiarize himself with the unit's circuit operation by reading Section 2 before attempting alignment of the instrument. Test of the unit for spurious level and harmonic distortion requires a high frequency oscilloscope and a sampling scope.

Section 4.2 gives a discussion of the internal controls which require identification during alignment of the unit. Subsequent sections describe in detail the alignment procedure for each circuit. All internal controls are properly adjusted at the factory and only minor adjustments should be required in the field due to aging or changing of components.

4.2 EXPLANATION OF INTERNAL CONTROLS

Refer to figure 4-1 to identify the location of each of the following controls.

4.2.1 R6, +30 Volt Adjust

Adjusts the output voltage of the +30 volt power supply.

4.2.2 R12, -30 Volt Adjust

Adjusts the output voltage of the -30 volt power supply.

4.2.3 R19, +110 Volt Adjust

Adjusts the output voltage of the +110 volt power supply.

4.2.4 R101, Upper Trigger Point Adjust

Adjusts the upper trigger point for the Schmidt Trigger in the rate generator.

4.2.5 R106, Line DC Level Adjust

Adjusts the DC level of the rate generator output voltage in the line rate mode of operation so that it is equal to the DC level in the variable rate mode.

4.2.6 R113, Lower Trigger Point Adjust

Adjusts the lower trigger point for the Schmidt Trigger in the rate generator.

4.2.7 R117, Line Trigger Amplitude Adjust

Adjusts the amplitude of the rate generator output voltage in the line rate mode of operation so that it is equal to the amplitude in the variable rate mode.

4.2.8 R127, Linearity Drive Level Adjust

Adjusts the DC level of the linearity drive voltage.

4.2.9 R129, Linearity Drive Size Adjust

Adjusts the amplitude of the linearity drive voltage.

4.2.10 R137, Varactor Drive Size Adjust

Adjusts the amplitude of the drive signal as provided by transistor stages Q106 and Q107. R137 and R129 are both sweep width limit potentiometers, but they have different effects on linearity.

4.2.11 R142,R143,R144,R145--Linearity Adjustments

These controls are adjusted to vary the shape of the sweep drive waveform for one sweep oscillator.

4.2.12 R152,R153,R154--Linearity Adjustments

These controls are adjusted to vary the shape of the sweep drive waveform for the second sweep oscillator

4.2.13 R159, Low Frequency Calibration Adjust

Sets the low frequency limit of the calibrated frequency range.

4.2.14 R164, High Frequency Calibration Mount

Sets the high frequency limit of the calibrated frequency range.

4.2.15 R305,R306,R311,R312,R317,R318,R324,R325--Marker Size Adjustments

These controls provide individual adjustment of the marker size available from plug-in marker receptacles one through eight.

4.3 POWER SUPPLY

4.3.1

With the unit plugged in and the power switch on, monitor the -30v point with an accurate voltmeter and a high gain AC coupled oscilloscope at the emitter of Q7.

4.3.2

Adjust R12, the -30 volt adjust potentiometer, for a -30 volt level. The AC ripple, as viewed on the scope, should be about 4 mv.

4.3.3

Connect the meter and scope to the emitter of Q1 and adjust R6 for a +30 volt level. The ripple should be about 6 mv.

4.3.4

Connect the meter and scope to the emitter of Q8 and adjust R19 for a +110 volt level. The ripple should be about 6 mv.

4.4 RATE GENERATOR

4.4.1

To align the rate generator perform the following operations:

4.4.1.1

Connect a direct coupled oscilloscope to the emitter of Q105.

4.4.1.2

Set the sweep rate function switch to manual.

4.4.1.3

Turn the power switch on.

4.4.2

Note the limits of the voltage at emitter Q105 as R118 (the potentiometer concentric with the sweep rate switch) is rotated to both ends of its range. This voltage should vary from 1 volt to +19.75 volts $\pm$ 0.25 volts. If it doesn't, refer to Section 5 for trouble shooting instructions.

4.4.3

Set R118 to its mid-range, switch the sweep rate function switch to the variable position, and adjust R113 (Lower Trigger Point Adjust) and R101 (Upper Trigger Point Adjust) so that the triangular wave, as viewed on the oscilloscope, varies between the same limits noted in Section 4.4.2.

4.4.4

Rotate R118 throughout its range and, using the time base on the oscilloscope, verify that the frequency of the triangular wave is adjustable from below 5 Hz to above 60 Hz. As R118 is varied, the amplitude of the waveform should remain nearly constant.

4.4.5

Switch the sweep rate function switch to Line Position and adjust R106 and R117 until the triangular wave amplitude and DC level are the same as noted in 4.4.4.

4.4.6

Disconnect the scope probe from Q105 and connect it to the emitter of Q109. The presence of a 0 to 20 volt square wave indicates that the blanking circuit is operating.

4.4.7

If any of the steps cannot be completed, refer to Section 5 for trouble shooting procedures.

4.5 LINEARITY CIRCUIT

4.5.1

The linearity and sweep width of this unit can be adjusted by performing the following operations.

4.5.2

Connect the unit to the oscilloscope as indicated in the typical test setup, figure 3-2, but omit the device under test.

4.5.3

The best method to use when adjusting sweep width and linearity requires a 10 MHz harmonic marker (HM-10). If another harmonic marker is available, it can be employed with note taken of the changes required in the following procedure.

4.5.4

If a 10 MHz harmonic marker is used, center the 50 MHz marker on the scope display while the unit is at minimum sweep width. Adjust the scope horizontal gain for 10 cm horizontal deflection.

4.5.5

Advance the sweep width potentiometer (front panel control) to full sweep width and note any position change of the 50 MHz birdy marker. If there is any shift, recenter with the linearity drive level control, R127.

4.5.6

With the sweep width set at maximum, there should be 10 markers present on the scope trace with 10 marker intervals from 0 to 100 MHz. If the sweep width is too narrow or too wide, adjust R129, linearity drive size, for the proper 100 MHz sweep width.

4.5.7

To set linearity requires adjustment of R143 (LIN #1), R142 (LIN #1A), R145 (LIN #2), R147 (LIN #2A), R154 (LIN #3), R153 (LIN #3A), R151 (LIN #4), and R152 (LIN #4A) controls. These controls interact somewhat, and it may be necessary to repeat the following sequence to obtain the specified linearity.

4.5.8

Adjust the center frequency control so that zero frequency is at the graticule furthest to the left and 100 MHz at the furthest graticule to the right.

4.5.9

Adjust LIN #3, LIN #3A, LIN #4, and LIN #4A to align the 0, 10, 20, 30, and 40 MHz markers on the 1 cm graticule lines. It may not be possible to exactly align these markers, but set them as close as possible and go on to the next step.

4.5.10

Adjust LIN #1, LIN #1A, LIN #2, and LIN #2A to align 60, 70, 80, 90, and 100 MHz markers on the 1 cm graticule lines. You will note that this procedure will also move the lower frequency markers, and it may be necessary to repeat step 4.5.9.

4.5.11

When properly aligned, the oscilloscope presentation will be as shown in figure 4-2. If the unit is meeting its specification of 1.2 to 1 linearity, no interval is more than 1.2 times as great as any other interval.

Figure 4-2
PRESENTATION OF LINEARIZED OUTPUT

4.5.12

If it is not possible to set linearity with the adjustments in 4.5.9 and 4.5.10, it may be necessary to adjust varactor drive size, R137. R137 changes the sensitivity of the linearity adjustments so that after varying R137, steps 4.5.9 and 4.5.10 should be repeated. It is not generally advisable to adjust R137 because it drastically affects the calibration of the unit. If it is necessary to make this adjustment, it will not be possible to accurately recalibrate with internal adjustments, but a new dial calibration may be necessary.

4.5.13

Check the frequency dial calibration as indicated by proper centering of frequency markers at minimum sweep width. If zero calibration is off, adjust R159, low frequency calibration adjust, for proper calibration.

4.5.14

If 100 MHz calibration is off, adjust R146, high frequency adjust, for proper calibration. There is some interaction between these two controls; thus, steps 4.5.13 and 4.5.14 should be repeated several times until the best possible calibration is obtained.

4.6 RF LEVEL ADJUSTMENT

4.6.1

With the same setup as used in Section 4.5, set the RF vernier for maximum output.

4.6.2

Being certain that the monitor switch is set for internal monitoring, adjust the maximum level potentiometer for 1.0v detected output level as noted from the oscilloscope calibrated display.

4.6.3

Switch in 6 db of attenuation and note the vertical deflection on the oscilloscope.

4.6.4

Rotate the RF vernier for minimum output, remove the 6 db of attenuation, and adjust the minimum level potentiometer for the same level of detected output as noted in 4.6.3.

4.7 MARKER SIZE

4.7.1

Individual marker size controls are provided, as well as the front panel control, so that if a complicated set of markers are employed, their relative sizes can be set for easy identification.

4.7.2

For example, if 50 MHz, 10 MHz, and 1 MHz harmonic markers are all used, adjust the internal control for the HM-50 for 0.2 volt birdies, the HM-10 for 0.1 volt, and the HM-1 for 0.05 volt producing an easily identified display.

4.8 SWEEP OSCILLATORS, MIXER, AND VIDEO AMPLIFIER

These circuits are such that adjustment of internal controls to realign is impractical. They are designed to require no adjustment in the field. These circuits should only be investigated when trouble shooting procedures have isolated a problem to that area.

4.9 SPURIOUS CONTENT AND HARMONIC DISTORTION

4.9.1

The simplest way to determine the distortion and harmonic content level is with a sampling oscilloscope and a high frequency oscilloscope (i.e. a Tektronix 547 and 1A1 and 1S1 heads).

4.9.2

Set the VS-30 for CW operation near 100 kHz.

4.9.3

Connect the RF output to a high frequency oscilloscope (i.e. Tektronix 547 with 1A1 head) and adjust the oscilloscope for a 6 cm vertical display.

4.9.4

Adjust the time base of the oscilloscope for one or two cycles of RF and note the deviation from a sinewave.

4.9.5

Vary the center frequency of the unit between 1 and 50 MHz and note the distortion.

4.9.6

If the unit meets its shipping specification, the distortion as measured with the following formula, will be less than 5%.

4.9.7

Given the presentation shown in figure 4-3, a measure of distortion can be obtained by calculating $\frac{A-B}{A+B}100=$ % Distortion

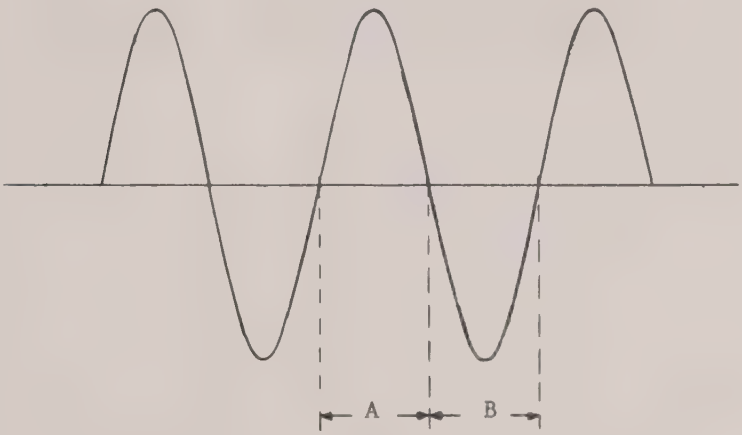


FIGURE 4-3
LOW FREQUENCY DISTORTION DISPLAY

4.9.8

Adjust the high frequency oscilloscope time base for at least 10 cycles of RF and note if any lower frequency modulation is present when the unit is tuned from 100 kHz to 50 MHz.

4.9.9

A typical presentation is shown in figure 4-4. The spurious level is easily calculated from the formula $20 \log_{10}\frac{A}{a}$ = Spurious Level in DB

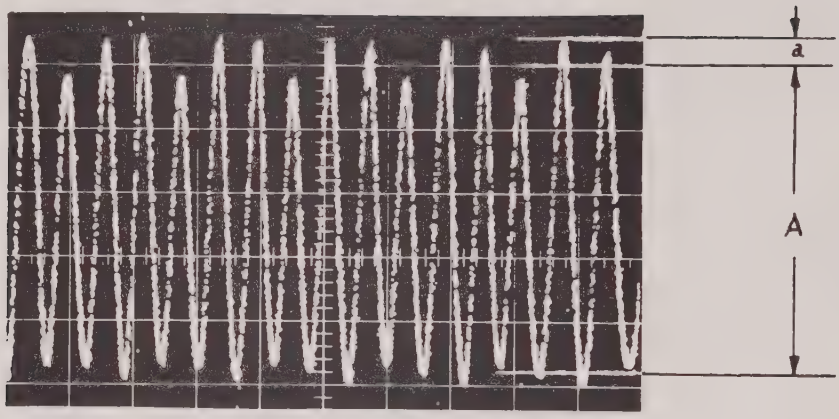


FIGURE 4-4
SPURIOUS LEVEL TEST DISPLAY

4.9.10

If the unit is operating normally, this level is typically more than 30 db down.

4.9.11

Substitute a sampling oscilloscope for the high frequency oscilloscope (i.e. the 1S1 head for the 1A1 head) and repeat steps 4.9.3 through 4.9.10 while varying the VS-30 between 50 MHz and 100 MHz.

SECTION 5

MAINTENANCE

5.1 INTRODUCTION

As in trouble shooting any electronic equipment, the best approach is to systemically attempt to isolate the problem to a particular circuit, and then a component, by the process of elimination. Before attempting to find any failure, it is suggested that the trouble shooting technician or engineer become familiar with the equipment by reading Sections 2 and 3 of this manual. The following section, Section 5.2, presents a trouble shooting chart which lists some of the more common failures. This chart should assist in finding or localizing the defective part. A VTVM and an oscilloscope should be sufficient tools in testing the unit.

5.2 TROUBLE SHOOTING CHART

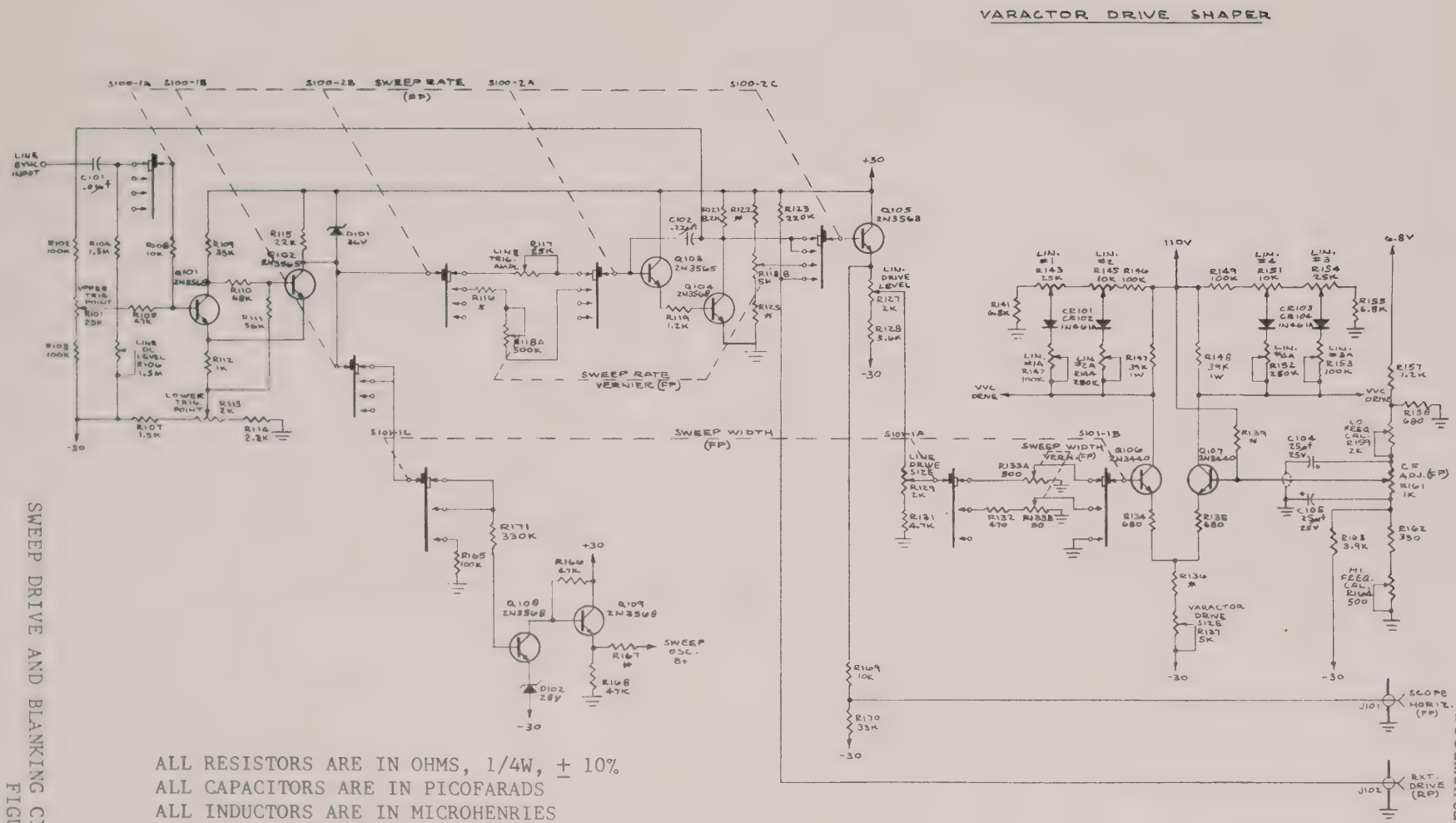
SYMPTOM	CHECK
5.2.1	
Power Switch On, But The Pilot Light Does Not Come On	F1
5.2.2	
F1 Blows When The Unit Is Turned On	Shorts across power supply outputs. Power supply transistors. Power supply rectifiers. T1.
5.2.3	
No RF Output	Power supply voltage. Leveler voltage. Oscillator transistors (Q501,Q502, Q503,Q504). CR503. R432. Video amplifier transistors.
5.2.4	
Insufficient RF Output	Max level set potentiometer, R456. CR503. Video amplifier transistors. +30 volt supply -30 volt supply Leveler transistors (Q451,Q452,Q453, Q454) Sweep oscillator output
5.2.5	
No Horizontal Output	Q101,Q102,Q103,Q104,Q108, and Q109

SYMPTOM	CHECK
5.2.6	
No Birdy Markers	L301 shorted. Q306,Q307, and Q305.
5.2.7	
Individual Marker Plug-In Socket Produces No Birdies	Individual amplifier transistors (301, Q302,Q303, or Q304)
5.2.8	
No External Marker Capability	CR351 Q306
5.2.9	
Flatness Not Meeting Specification	CR401 Leveler transistors (Q451,Q452,Q453, and Q454)
5.2.10	
+30V Not Present Or Has Excessive Ripple	CR5, CR6, C1C, and C6 Q1, Q2, Q3, and Q4
5.2.11	
-30V Not Present Or Has Excessive Ripple	CR3, CR4, C7, C11 Q5, Q6, Q7
5.2.12	
+110V Not Present Or Has Excessive Ripple	CR1, CR2, C1A, C1B, C14 Q8, Q9, Q10
5.2.13	
Power Supply Voltages Don't Adjust Properly	D2, D3, D4, D5, and D6 Transistors in power supply
5.2.14	
Insufficient Sweep Width	+110V supply Q106, Q107, and Q105

SYMPTOM	CHECK
5.2.15	
No Blanking	Q108 and Q109
5.2.16	
Center Frequency Doesn't Adjust	+110V supply Q106 and Q107

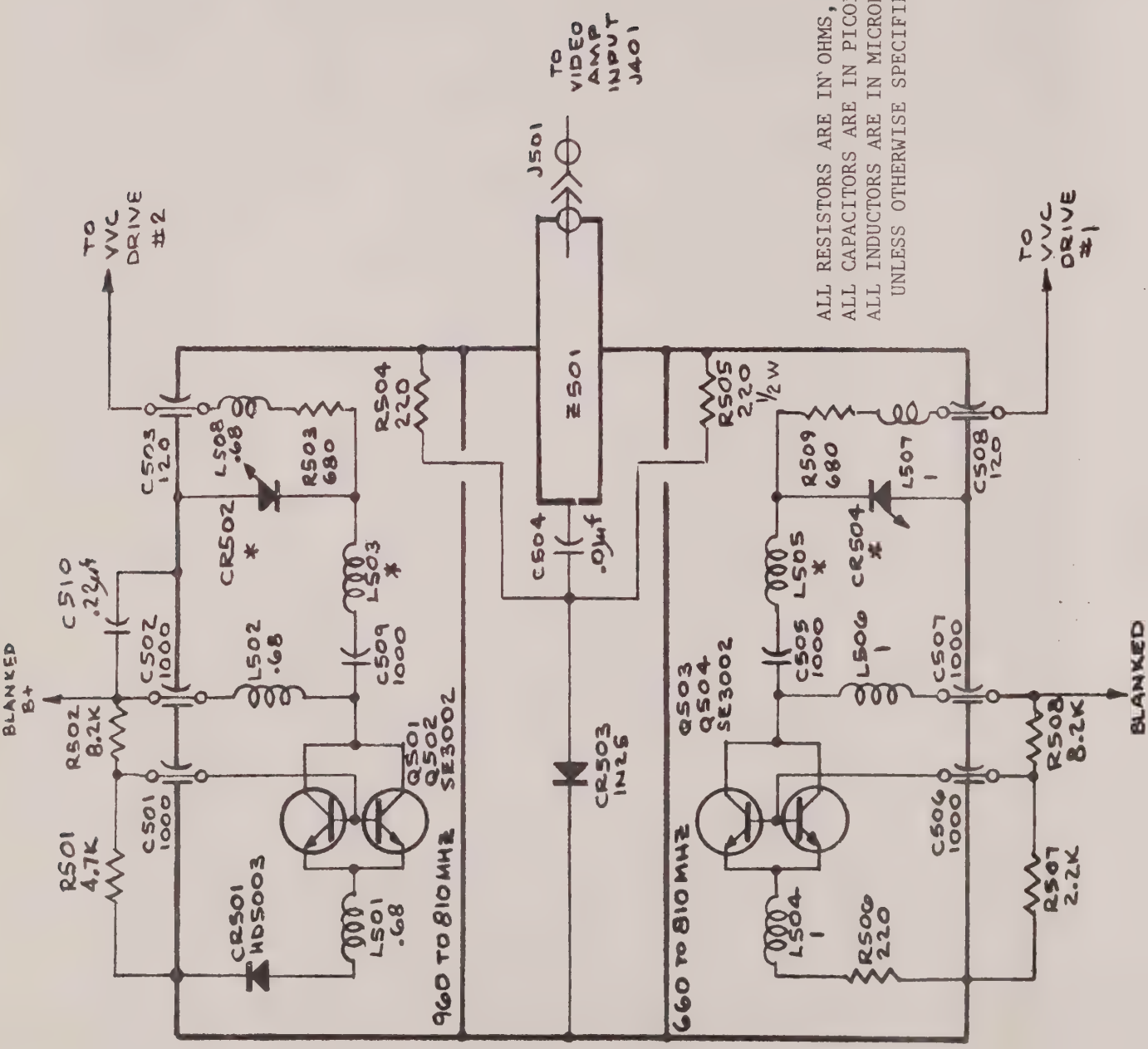
SECTION 6

DOCUMENTATION

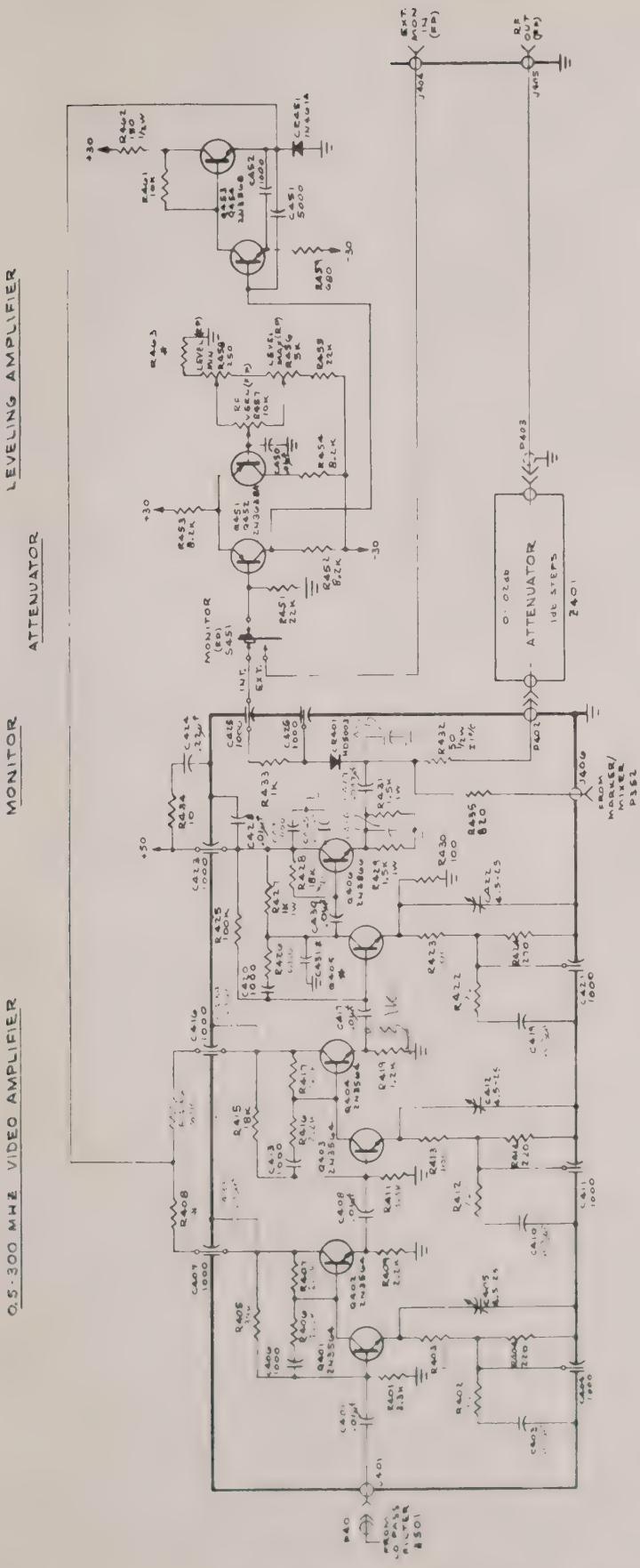


ALL RESISTORS ARE IN OHMS, 1/4W, ± 10%
ALL CAPACITORS ARE IN PICOFARADS
ALL INDUCTORS ARE IN MICROHENRIES
UNLESS OTHERWISE SPECIFIED

SWEEP DRIVE AND BLANKING CIRCUITS
FIGURE 6-1
6-1

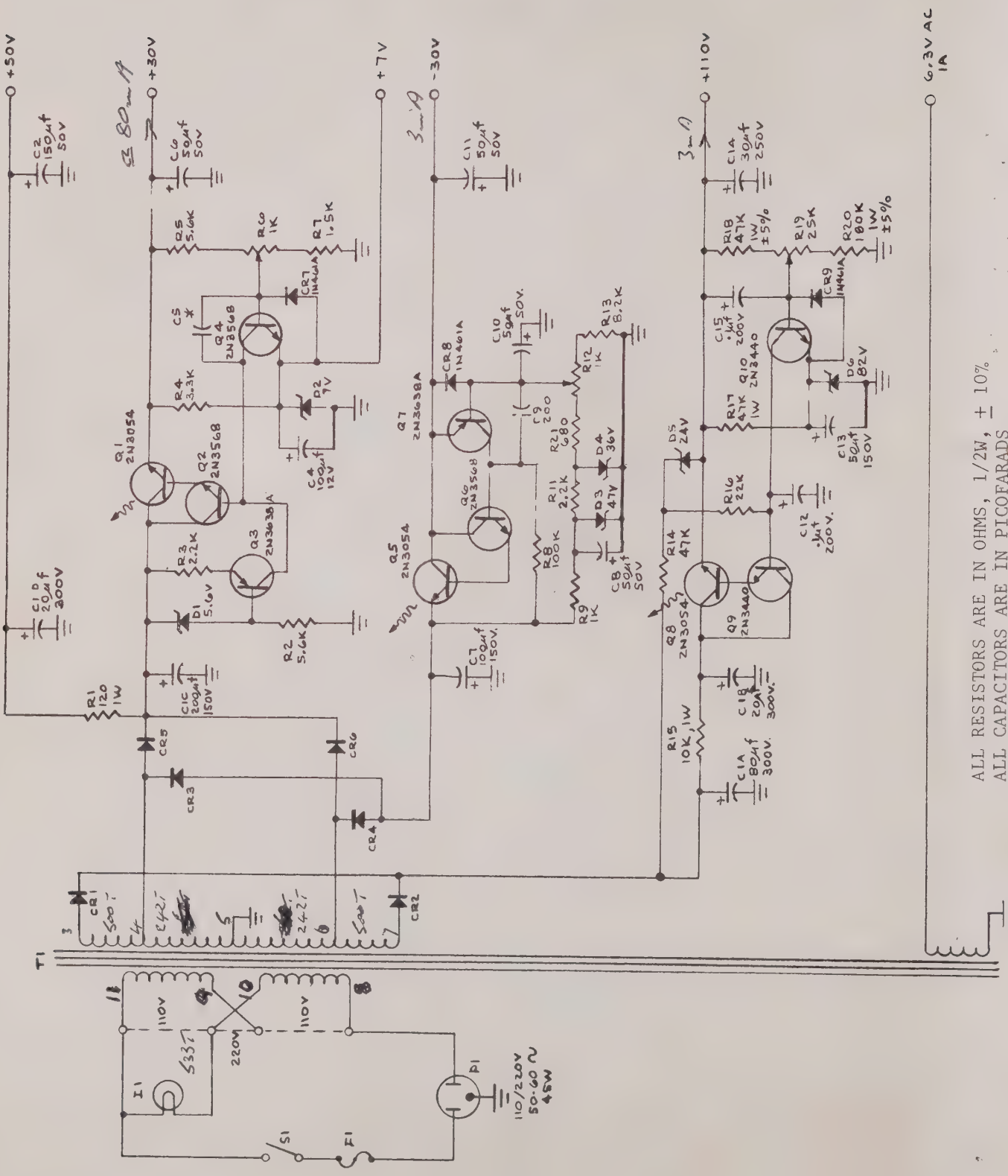


SWEEP OSCILLATORS AND MIXER
FIGURE 6-2



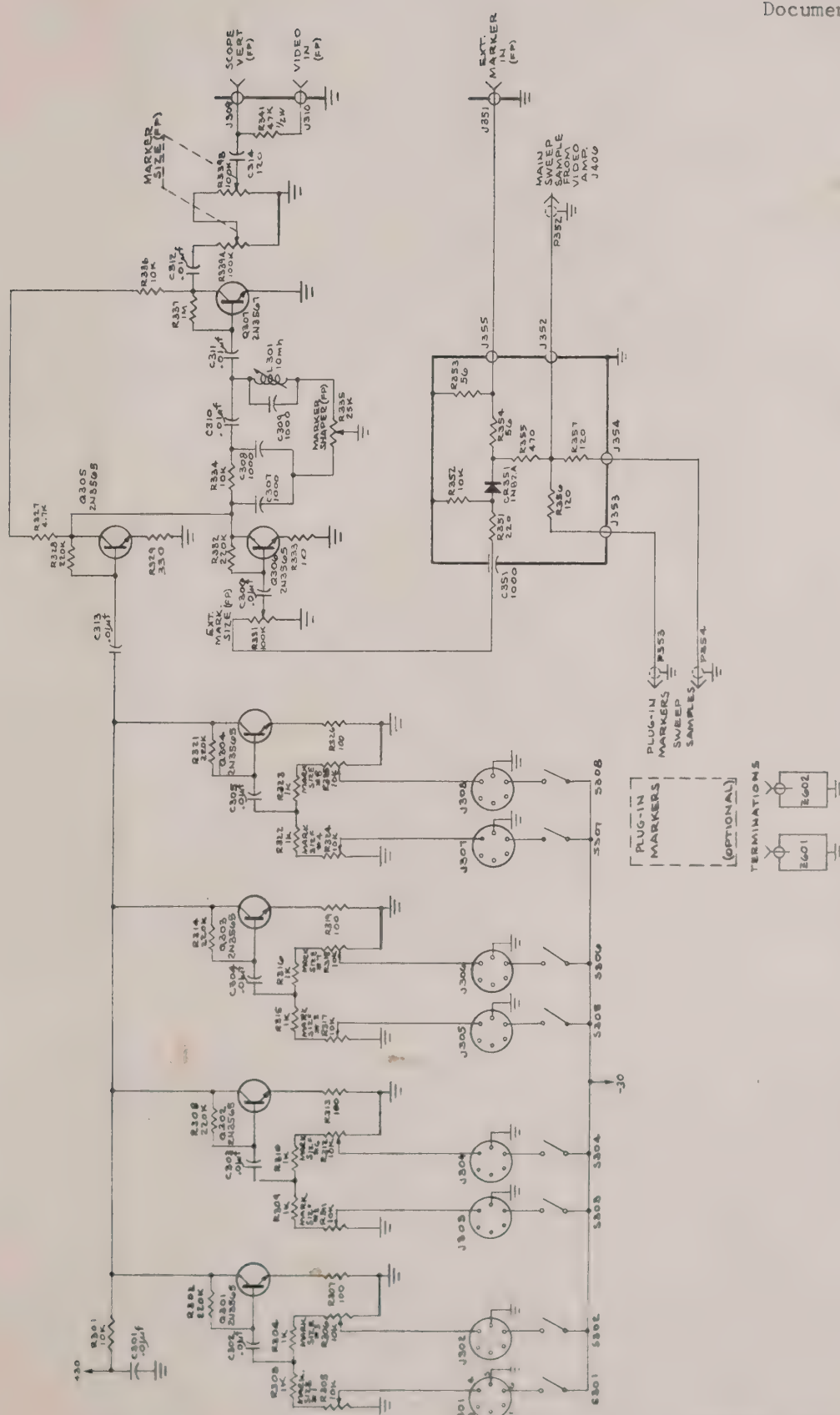
ALL RESISTORS ARE IN OHMS, 1/4W, ± 10%
ALL CAPACITORS ARE IN PICOFARADS
ALL INDUCTORS ARE IN MICROHENRIES
UNLESS OTHERWISE SPECIFIED

VIDEO AMPLIFIER AND LEVELER CIRCUITRY
FIGURE 6-3



ALL RESISTORS ARE IN OHMS, 1/2W, ± 10%
ALL CAPACITORS ARE IN PICOFARADS
ALL INDUCTORS ARE IN MICROHENRIES
UNLESS OTHERWISE SPECIFIED

POWER SUPPLY
FIGURE 6-4
6-4



ALL RESISTORS ARE IN OHMS, 1/4W, ± 10%
ALL CAPACITORS ARE IN PICOFARADS
ALL INDUCTORS ARE IN MICROHENRIES
UNLESS OTHERWISE SPECIFIED

MARKER CIRCUITRY
FIGURE 6-5

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
C1A,C1B, C1C, C1D	012-075	Capacitor, Fixed, 20uf, 300V; 200uf, 150V; 80uf, 300V; 20uf, 300V	Mallory WP 419.39A
C2	012-102	Capacitor, Fixed, 150uf, 50V	Cornell-Dubilier 19Z147
C3		Not used	
C4	012-015	Capacitor, Fixed, 100uf, 12V	Sprague 30D107G012DC4
C5		Factory selected value	
C6	012-082	Capacitor, Fixed, 50uf, 50V	Mallory PET 1980
C7	012-079	Capacitor, Fixed, 100uf, 150V	Mallory FP 116A
C8	012-082	Capacitor, Fixed, 50uf, 50V	Mallory PET 1980
C9	012-052	Capacitor, Fixed, 200pf	RMC Type C N1500
C10	012-082	Capacitor, Fixed, 50uf, 50V	Mallory PET 1980
C11	012-082	Capacitor, Fixed, 50uf, 50V	Mallory PET 1980
C12	012-023	Capacitor, Fixed, 0.1uf, 200V	Standard Condenser MBA 200
C13	012-061	Capacitor, Fixed, 50uf, 150V	Sprague TVA 1414
C14	012-026	Capacitor, Fixed, 30uf, 250V	Cornell Dubilier BR30-250
C15	012-023	Capacitor, Fixed, 0.1uf, 200V	Standard Condenser MBA 200
C101	012-005	Capacitor, Fixed, 0.01uf, 500V	RMC Z5U.01
C102	012-020	Capacitor, Fixed, 0.22uf, 100V	Cornell Dubilier DMF 1P22
C103		Not used	
C104	012-064	Capacitor, Fixed, 25uf, 25V	Sprague TE 1207
C105	012-064	Capacitor, Fixed, 25uf, 25V	Sprague TE1207
C301	012-005	Capacitor, Fixed, 0.01uf, 500V	RMC Z5U.01
C302	012-005	Capacitor, Fixed, 0.01uf, 500V	RMC Z5U.01
C303	012-005	Capacitor, Fixed, 0.01uf, 500V	RMC Z5U.01
C304	012-005	Capacitor, Fixed, 0.01uf, 500V	RMC Z5U.01
C305	012-005	Capacitor, Fixed, 0.01uf, 500V	RMC Z5U.01
C306	012-050	Capacitor, Fixed, 0.01uf, 100V	RMC TA.01
C307	012-009	Capacitor, Fixed, 1000pf, 500V	RMC SM.001
C308	012-009	Capacitor, Fixed, 1000pf, 500V	RMC SM.001
C309	012-009	Capacitor, Fixed, 1000pf, 500V	RMC SM.001
C310	012-050	Capacitor, Fixed, 0.01uf, 100V	RMC TA.01
C311	012-050	Capacitor, Fixed, 0.01uf, 100V	RMC TA.01
C312	012-050	Capacitor, Fixed, 0.01uf, 100V	RMC TA.01
C313	012-005	Capacitor, Fixed, 0.01uf, 500V	RMC Z5U.01
C314	012-013	Capacitor, Fixed, 120pf	RMC C120 N1500

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
C351	012-001	Capacitor, Fixed, 1000pf feed-thru	Allen Bradley FA5C GMV
C401	012-050	Capacitor, Fixed, 0.01uf, 100V	RMC TA.01
C402		Not used	
C403	012-114	Capacitor, Fixed, 0.02uf	RMC TA.02
C404	012-037	Capacitor, Fixed, 1000pf standoff	Allen Bradley SS5A-102W
C405	015-003	Capacitor, Variable, 4.5-25pf	Centralab 822CN
C406	012-009	Capacitor, Fixed, 0.001uf, 500V	RMC SM.001
C407	012-001	Capacitor, Fixed, 1000pf feed-thru	Allen Bradley FA5C GMV
C408	012-050	Capacitor, Fixed, 0.01uf, 100V	RMC TA.01
C409		Not used	
C410	012-114	Capacitor, Fixed, 0.02uf	RMC TA.02
C411	012-037	Capacitor, Fixed, 1000pf standoff	Allen Bradley SS5A-102W
C412	015-003	Capacitor, Variable, 4.5-25pf	Centralab 822CN
C413	012-009	Capacitor, Fixed, 0.001uf, 500V	RMC SM.001
C414		Not used	
C415		Not used	
C416	012-001	Capacitor, Fixed, 1000pf feed-thru	Allen Bradley FA5C GMV
C417	012-050	Capacitor, Fixed, 0.01uf, 100V	RMC TA.01
C418		Not used	
C419	012-114	Capacitor, Fixed, 0.02uf	RMC TA.02
C420	012-009	Capacitor, Fixed, 0.001uf, 500V	RMC SM.001
C421	012-037	Capacitor, Fixed, 1000pf standoff	Allen Bradley SS5A-102W
C422	015-003	Capacitor, Variable, 4.5-25pf	Centralab 822CN
C423	012-001	Capacitor, Fixed, 1000pf feed-thru	Allen Bradley FA5C GMV
C424	012-020	Capacitor, Fixed, 0.22uf, 100V	Cornell Dubilier DMF 1P22
C425	012-001	Capacitor, Fixed, 1000pf feed-thru	Allen Bradley FA5C GMV
C426	012-037	Capacitor, Fixed, 1000pf standoff	Allen Bradley SS5A-102W
C427	012-125	Capacitor, Fixed, 0.047uf, 100V	Arco Elmenco 1DP-2-473
C428	012-050	Capacitor, Fixed, 0.01uf, 100V	RMC TA.01
C429		Not used	
C430	012-050	Capacitor, Fixed, 0.01uf, 100V	RMC TA.01
C431		Factory selected value	
C432	012-009	Capacitor, Fixed, 0.001uf, 500V	RMC SM.001
C433	012-050	Capacitor, Fixed, 0.01uf, 100V	RMC TA.01
C434	012-050	Capacitor, Fixed, 0.01uf, 100V	RMC TA.01
C435	012-050	Capacitor, Fixed, 0.01uf, 100V	RMC TA.01
C436	012-057	Capacitor, Fixed, 7pf	RMC Type C TC-NPO
C437	012-057	Capacitor, Fixed, 7pf	RMC Type C TC-NPO
C450	012-050	Capacitor, Fixed, 0.01uf, 100V	RMC TA.01
C451	012-085	Capacitor, Fixed, 5000pf, 500V	RMC SM.005
C452	012-009	Capacitor, Fixed, 0.001uf, 500V	RMC SM.001

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
C501	012-001	Capacitor, Fixed, 1000pf feed-thru	Allen Bradley FA5C GMV
C502	012-001	Capacitor, Fixed, 1000pf feed-thru	Allen Bradley FA5C GMV
C503	012-058	Capacitor, Fixed, 120pf feed-thru	Allen Bradley FA5C
C504	012-050	Capacitor, Fixed, 0.01uf, 100V	RMC TA.01
C505	012-037	Capacitor, Fixed, 1000pf standoff	Allen Bradley SS5A-102W
C506	012-001	Capacitor, Fixed, 1000pf feed-thru	Allen Bradley FA5C GMV
C507	012-001	Capacitor, Fixed, 1000pf feed-thru	Allen Bradley FA5C GMV
C508	012-058	Capacitor, Fixed, 120pf feed-thru	Allen Bradley FA5C
C509	012-037	Capacitor, Fixed, 1000pf standoff	Allen Bradley SS5A-102W
C510	012-020	Capacitor, Fixed, 0.22uf, 100V	Cornell Dubilier DMF 1P22
CR1	025-007	Diode, A13D2	General Electric A13D2
CR2	025-007	Diode, A13D2	General Electric A13D2
CR3	025-007	Diode, A13D2	General Electric A13D2
CR4	025-007	Diode, A13D2	General Electric A13D2
CR5	025-007	Diode, A13D2	General Electric A13D2
CR6	025-007	Diode, A13D2	General Electric A13D2
CR7	025-005	Diode, 1N461A	Texas Instrument 1N461A
CR8	025-005	Diode, 1N461A	Texas Instrument 1N461A
CR9	025-005	Diode, 1N461A	Texas Instrument 1N461A
CR101	025-005	Diode, 1N461A	Texas Instrument 1N461A
CR102	025-005	Diode, 1N461A	Texas Instrument 1N461A
CR103	025-005	Diode, 1N461A	Texas Instrument 1N461A
CR104	025-005	Diode, 1N461A	Texas Instrument 1N461A
CR351	025-002	Diode, 1N82A	Micro Optics 1N82A
CR401	025-016	Diode, HD5003	Hughes HD5003
CR451	025-005	Diode, 1N461A	Texas Instrument 1N461A
CR501	025-016	Diode, HD5003	Hughes HD5003
CR502		Factory selected value	
CR503	025-028	Diode, 1N25	Sylvania 1N25
CR504		Factory selected value	
D1	025-018	Diode, Zener, 1N708, 5.6V	Texas Instrument
D2	025-033	Diode, Zener, VR7A, 7V	Sarkes Tarzian VR7A
D3	025-021	Diode, Zener, ZA47, 47V	Mallory ZA47

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
D4	025-022	Diode, Zener, ZA36, 36V	Mallory ZA36
D5	025-011	Diode, Zener, ZA24A	Mallory ZA24A
D6	025-019	Diode, Zener, ZA82, 82V	Mallory ZA82
D101	025-022	Diode, Zener, ZA36, 36V	Mallory ZA36
D102	025-024	Diode, Zener, VR28, 28V	Sarkes Tarzian VR28
F1	034-001	Fuse, 3AG, 1A	Littelfuse 312001
I1	011-001	Bulb, Pilot Light	Drake 6063-634
J101	020-016	Connector, RF	Star 5069
J102	020-011	Connector, RF, UG625B/U	Star UG625B/U
J301	054-003	Socket, 6 pin	Cinch 201-41-06-243
J302	054-003	Socket, 6 pin	Cinch 201-41-06-243
J303	054-003	Socket, 6 pin	Cinch 201-41-06-243
J304	054-003	Socket, 6 Pin	Cinch 201-41-06-243
J305	054-003	Socket, 6 Pin	Cinch 201-41-06-243
J306	054-003	Socket, 6 Pin	Cinch 201-41-06-243
J307	054-003	Socket, 6 Pin	Cinch 201-41-06-243
J308	054-003	Socket, 6 Pin	Cinch 201-41-06-243
J309	020-016	Connector, RF	Star 5069
J310	020-016	Connector, RF	Star 5069
J351	020-017	Connector, RF	Star 5070
J352	020-018	Connector, RF, MX1684/U	Star MX1684/U
J353	020-018	Connector, RF, MX1684/U	Star MX1684/U
J354	020-018	Connector, RF, MX1684/U	Star MX1684/U
J355	020-018	Connector, RF, MX1684/U	Star MX1684/U
J401	020-011	Connector, RF, UG625B/U	Star UG625B/U
J402		Not used	
J403		Not used	
J404	020-016	Connector, RF	Star 5069
J405	020-017	Connector, RF	Star 5070
J406	020-011	Connector, RF, UG625B/U	Star UG625B/U
J501	020-017	Connector, RF	Star 5070
L301	035-008	Inductor, 10mh	Central Coil H-0813-15
L501	035-004	Inductor, 0.68uh	Jeffers 4426-4K

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
L502	035-004	Inductor, 0.68uh	Jeffers 4426-4K
L503		Factory selected value	
L504	035-001	Inductor, 1uh	Jeffers 4426-6K
L505		Factory selected value	
L506	035-001	Inductor, 1uh	Jeffers 4426-6K
L507	035-001	Inductor, 1uh	Jeffers 4426-6K
L508	035-004	Inductor, 0.68uh	Jeffers 4426-4K
P1	019-004	Conductor, Line Cord	Alpha Wire 615
P352	020-021	Connector, RF, UG88C/U	Star UG88C/U
P353	020-021	Connector, RF, UG88C/U	Star UG88C/U
P354	020-021	Connector, RF, UG88C/U	Star UG88C/U
P401	020-021	Connector, RF, UG88C/U	Star UG88C/U
P402	020-011	Connector, RF, UG625B/U	Star UG625B/U
P403	020-021	Connector, RF, UG88C/U	Star UG88C/U
Q1	062-006	Transistor, 2N3054	RCA 2N3054
Q2	062-015	Transistor, 2N3568	Fairchild 2N3568
Q3	062-010	Transistor, 2N3638A	Fairchild 2N3638A
Q4	062-015	Transistor, 2N3568	Fairchild 2N3568
Q5	062-006	Transistor, 2N3054	RCA 2N3054
Q6	062-015	Transistor, 2N3568	Fairchild 2N3568
Q7	062-010	Transistor, 2N3638A	Fairchild 2N3638A
Q8	062-006	Transistor, 2N3054	RCA 2N3054
Q9	062-008	Transistor, 2N3440	RCA 2N3440
Q10	062-008	Transistor, 2N3440	RCA 2N3440
Q101	062-002	Transistor, 2N3565	Fairchild 2N3565
Q102	062-002	Transistor, 2N3565	Fairchild 2N3565
Q103	062-002	Transistor, 2N3565	Fairchild 2N3565
Q104	062-015	Transistor, 2N3568	Fairchild 2N3568
Q105	062-015	Transistor, 2N3568	Fairchild 2N3568
Q106	062-008	Transistor, 2N3440	RCA 2N3440
Q107	062-008	Transistor, 2N3440	RCA 2N3440
Q108	062-015	Transistor, 2N3568	Fairchild 2N3568
Q109	062-015	Transistor, 2N3568	Fairchild 2N3568

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
Q301	062-002	Transistor, 2N3565	Fairchild 2N3565
Q302	062-002	Transistor, 2N3565	Fairchild 2N3565
Q303	062-002	Transistor, 2N3565	Fairchild 2N3565
Q304	062-002	Transistor, 2N3565	Fairchild 2N3565
Q305	062-002	Transistor, 2N3565	Fairchild 2N3565
Q306	062-002	Transistor, 2N3565	Fairchild 2N3565
Q307	062-003	Transistor, 2N3567	Fairchild 2N3567
Q401	062-001	Transistor, 2N3564	Fairchild 2N3564
Q402	062-001	Transistor, 2N3564	Fairchild 2N3564
Q403	062-001	Transistor, 2N3564	Fairchild 2N3564
Q404	062-001	Transistor, 2N3564	Fairchild 2N3564
Q405		Factory selected value	
Q406	062-016	Transistor, 2N3866	Vector 2N3866
Q451	062-010	Transistor, 2N3638A	Fairchild 2N3638A
Q452	062-010	Transistor, 2N3638A	Fairchild 2N3638A
Q453	062-015	Transistor, 2N3568	Fairchild 2N3568
Q454	062-015	Transistor, 2N3568	Fairchild 2N3568
Q501	062-013	Transistor, SE3002	Fairchild SE3002
Q502	062-013	Transistor, SE3002	Fairchild SE3002
Q503	062-013	Transistor, SE3002	Fairchild SE3002
Q504	062-013	Transistor, SE3002	Fairchild SE3002
R1	046-372	Resistor, Fixed, 120ohm, 1W, ± 10%	Allen Bradley
R2	046-142	Resistor, Fixed, 5.6Kohm, ½W, ± 10%	Allen Bradley
R3	046-124	Resistor, Fixed, 2.2Kohm, ½W, ± 10%	Allen Bradley
R4	046-131	Resistor, Fixed, 3.3Kohm, ½W, ± 10%	Allen Bradley
R5	046-142	Resistor, Fixed, 5.6Kohm, ½W, ± 10%	Allen Bradley
R6	048-030	Resistor, Variable, 1Kohm	Texscan Corporation
R7	046-117	Resistor, Fixed, 1.5Kohm, ½W, ± 10%	Allen Bradley
R8	046-194	Resistor, Fixed, 100Kohm, ½W, ± 10%	Allen Bradley
R9	046-110	Resistor, Fixed, 1Kohm, ½W, ± 10%	Allen Bradley
R10		Not used	
R11	046-124	Resistor, Fixed, 2.2Kohm, ½W, ± 10%	Allen Bradley
R12	048-030	Resistor, Variable, 1Kohm	Texscan Corporation
R13	046-149	Resistor, Fixed, 8.2Kohm, ½W, ± 10%	Allen Bradley
R14	046-180	Resistor, Fixed, 47Kohm, ½W, ± 10%	Allen Bradley

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
R15	046-452	Resistor, Fixed, 10Kohm, 1W, ± 10%	Allen Bradley
R16	046-166	Resistor, Fixed, 22Kohm, ½W, ± 10%	Allen Bradley
R17	046-480	Resistor, Fixed, 47Kohm, 1W, ± 10%	Allen Bradley
R18	046-479	Resistor, Fixed, 47Kohm, 1W, ± 5%	Allen Bradley
R19	048-026	Resistor, Variable, 25Kohm	Texscan Corporation
R20	046-504	Resistor, Fixed, 180Kohm, 1W, ± 5%	Allen Bradley
R21	046-103	Resistor, Fixed, 680ohm, ½W, ± 10%	Allen Bradley
R101	048-026	Resistor, Variable, 25Kohm	Texscan Corporation
R102	045-794	Resistor, Fixed, 100Kohm, ¼W, ± 10%	Allen Bradley
R103	045-794	Resistor, Fixed, 100Kohm, ¼W, ± 10%	Allen Bradley
R104	045-843	Resistor, Fixed, 1.5Mohm, ¼W, ± 10%	Allen Bradley
R105	045-780	Resistor, Fixed, 47Kohm, ¼W, ± 10%	Allen Bradley
R106	048-033	Resistor, Variable, 1.5Mohm	Texscan Corporation
R107	045-717	Resistor, Fixed, 1.5Kohm, ¼W, ± 10%	Allen Bradley
R108	045-752	Resistor, Fixed, 10Kohm, ¼W, ± 10%	Allen Bradley
R109	045-773	Resistor, Fixed, 33Kohm, ¼W, ± 10%	Allen Bradley
R110	045-787	Resistor, Fixed, 68Kohm, ¼W, ± 10%	Allen Bradley
R111	045-784	Resistor, Fixed, 56Kohm, ¼W, ± 10%	Allen Bradley
R112	045-710	Resistor, Fixed, 1Kohm, ¼W, ± 10%	Allen Bradley
R113	048-023	Resistor, Variable, 2Kohm	Texscan Corporation
R114	045-724	Resistor, Fixed, 2.2Kohm, ¼W, ± 10%	Allen Bradley
R115	045-766	Resistor, Fixed, 22Kohm, ¼W, ± 10%	Allen Bradley
R116		Factory selected value	
R117	048-026	Resistor, Variable, 25Kohm	Texscan Corporation
R118A,R118B, S100	048-048	Resistor, Variable, 500K/5K,5P-4Pos.	Texscan Corporation
R119	045-714	Resistor, Fixed, 1.2Kohm, ¼W, ± 10%	Allen Bradley
R120		Not used	
R121	045-749	Resistor, Fixed, 8.2Kohm, ¼W, ± 10%	Allen Bradley
R122		Factory selected value	
R123	045-808	Resistor, Fixed, 220Kohm, ¼W, ± 10%	Allen Bradley
R124		Not used	
R125		Factory selected value	
R126		Not used	
R127	048-023	Resistor, Variable, 2Kohm	Texscan Corporation
R128	045-742	Resistor, Fixed, 5.6Kohm, ¼W, ± 10%	Allen Bradley

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
R129	048-023	Resistor, Variable, 2Kohm	Texscan Corporation
R130		Not used	
R131	045-738	Resistor, Fixed, 4.7Kohm, ¼W, ± 10%	Allen Bradley
R132	045-096	Resistor, Fixed, 470ohm, ¼W, ± 10%	Allen Bradley
R133A,R133B, S101	048-047	Resistor, Variable, 500/50ohm, 2P-3Pos.	Texscan Corporation
R134	045-703	Resistor, Fixed, 680ohm, ¼W, ± 10%	Allen Bradley
R135	045-703	Resistor, Fixed, 680ohm, ¼W, ± 10%	Allen Bradley
R136		Factory selected value	
R137	048-024	Resistor, Variable, 5Kohm	Texscan Corporation
R138		Not used	
R139		Factory selected value	
R140		Not used	
R141	045-745	Resistor, Fixed, 6.8Kohm, ¼W, ± 10%	Allen Bradley
R142	048-027	Resistor, Variable, 100Kohm	Texscan Corporation
R143	048-026	Resistor, Variable, 25Kohm	Texscan Corporation
R144	048-029	Resistor, Variable, 250Kohm	Texscan Corporation
R145	048-025	Resistor, Variable, 10Kohm	Texscan Corporation
R146	045-794	Resistor, Fixed, 100Kohm, ¼W, ± 10%	Allen Bradley
R147	046-477	Resistor, Fixed, 39Kohm, 1W, ± 10%	Allen Bradley
R148	046-477	Resistor, Fixed, 39Kohm, 1W, ± 10%	Allen Bradley
R149	045-794	Resistor, Fixed, 100Kohm, ¼W, ± 10%	Allen Bradley
R150		Not used	
R151	048-025	Resistor, Variable, 10Kohm	Texscan Corporation
R152	048-029	Resistor, Variable, 250Kohm	Texscan Corporation
R153	048-027	Resistor, Variable, 100Kohm	Texscan Corporation
R154	048-026	Resistor, Variable, 25Kohm	Texscan Corporation
R155	045-745	Resistor, Fixed, 6.8Kohm, ¼W, ± 10%	Allen Bradley
R156		Not used	
R157	045-714	Resistor, Fixed, 1.2Kohm, ¼W, ± 10%	Allen Bradley
R158	045-703	Resistor, Fixed, 680ohm, ¼W, ± 10%	Allen Bradley
R159	048-023	Resistor, Variable, 2Kohm	Texscan Corporation
R160		Not used	
R161	048-050	Resistor, Variable, 1Kohm	Texscan Corporation
R162	045-689	Resistor, Fixed, 330ohm, ¼W, ± 10%	Allen Bradley
R163	045-735	Resistor, Fixed, 3.9Kohm, ¼W, ± 10%	Allen Bradley
R164	048-022	Resistor, Variable, 500ohm	Texscan Corporation

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
R165	045-794	Resistor, Fixed, 100Kohm, ½W, ± 10%	Allen Bradley
R166	045-780	Resistor, Fixed, 47Kohm, ½W, ± 10%	Allen Bradley
R167		Factory selected value	
R168	045-780	Resistor, Fixed, 47Kohm, ½W, ± 10%	Allen Bradley
R169	045-752	Resistor, Fixed, 10Kohm, ½W, ± 10%	Allen Bradley
R170	045-773	Resistor, Fixed, 33Kohm, ½W, ± 10%	Allen Bradley
R171	045-815	Resistor, Fixed, 330Kohm, ½W, ± 10%	Allen Bradley
R301	045-752	Resistor, Fixed, 10Kohm, ½W, ± 10%	Allen Bradley
R302	045-808	Resistor, Fixed, 220Kohm, ½W, ± 10%	Allen Bradley
R303	045-710	Resistor, Fixed, 1Kohm, ½W, ± 10%	Allen Bradley
R304	045-710	Resistor, Fixed, 1Kohm, ½W, ± 10%	Allen Bradley
R305	048-014	Resistor, Variable, 10Kohm	Texscan Corporation
R306	048-014	Resistor, Variable, 10Kohm	Texscan Corporation
R307	045-668	Resistor, Fixed, 100ohm, ½W, ± 10%	Allen Bradley
R308	045-808	Resistor, Fixed, 220Kohm, ½W, ± 10%	Allen Bradley
R309	045-710	Resistor, Fixed, 1Kohm, ½W, ± 10%	Allen Bradley
R310	045-710	Resistor, Fixed, 1Kohm, ½W, ± 10%	Allen Bradley
R311	048-014	Resistor, Variable, 10Kohm	Texscan Corporation
R312	048-014	Resistor, Variable, 10Kohm	Texscan Corporation
R313	045-668	Resistor, Fixed, 100ohm, ½W, ± 10%	Allen Bradley
R314	045-808	Resistor, Fixed, 220Kohm, ½W, ± 10%	Allen Bradley
R315	045-710	Resistor, Fixed, 1Kohm, ½W, ± 10%	Allen Bradley
R316	045-710	Resistor, Fixed, 1Kohm, ½W, ± 10%	Allen Bradley
R317	048-014	Resistor, Variable, 10Kohm	Texscan Corporation
R318	048-014	Resistor, Variable, 10Kohm	Texscan Corporation
R319	045-668	Resistor, Fixed, 100ohm, ½W, ± 10%	Allen Bradley
R320		Not used	
R321	045-808	Resistor, Fixed, 220Kohm, ½W, ± 10%	Allen Bradley
R322	045-710	Resistor, Fixed, 1Kohm, ½W, ± 10%	Allen Bradley
R323	045-710	Resistor, Fixed, 1Kohm, ½W, ± 10%	Allen Bradley
R324	048-014	Resistor, Variable, 10Kohm	Texscan Corporation
R325	048-014	Resistor, Variable, 10Kohm	Texscan Corporation
R326	045-668	Resistor, Fixed, 100ohm, ½W, ± 10%	Allen Bradley
R327	045-738	Resistor, Fixed, 4.7Kohm, ½W, ± 10%	Allen Bradley
R328	045-808	Resistor, Fixed, 220Kohm, ½W, ± 10%	Allen Bradley
R329	045-689	Resistor, Fixed, 330ohm, ½W, ± 10%	Allen Bradley

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
R330		Not used	
R331	048-051	Resistor, Variable, 100Kohm	Texscan Corporation
R332	045-808	Resistor, Fixed, 220Kohm, ½W, ± 10%	Allen Bradley
R333	045-626	Resistor, Fixed, 10ohm, ½W, ± 10%	Allen Bradley
R334	045-752	Resistor, Fixed, 10Kohm, ½W, ± 10%	Allen Bradley
R335, R339A, R339B	048-060	Resistor, Variable, 25K/100K/100K	Texscan Corporation
R336	045-752	Resistor, Fixed, 10Kohm, ½W, ± 10%	Allen Bradley
R337	045-836	Resistor, Fixed, 1Mohm, ½W, ± 10%	Allen Bradley
R338		Not used	
R340		Not used	
R341	046-180	Resistor, Fixed, 47Kohm, ½W, ± 10%	Allen Bradley
R351	045-682	Resistor, Fixed, 220ohm, ½W, ± 10%	Allen Bradley
R352	045-752	Resistor, Fixed, 10Kohm, ½W, ± 10%	Allen Bradley
R353	045-658	Resistor, Fixed, 56ohm, ½W, ± 10%	Allen Bradley
R354	045-658	Resistor, Fixed, 56ohm, ½W, ± 10%	Allen Bradley
R355	045-696	Resistor, Fixed, 470ohm, ½W, ± 10%	Allen Bradley
R356	045-696	Resistor, Fixed, 470ohm, ½W, ± 10%	Allen Bradley
R357	045-696	Resistor, Fixed, 470ohm, ½W, ± 10%	Allen Bradley
R401	045-731	Resistor, Fixed, 3.3Kohm, ½W, ± 10%	Allen Bradley
R402	045-602	Resistor, Fixed, 2.7ohm, ½W, ± 10%	Allen Bradley
R403	045-668	Resistor, Fixed, 100ohm, ½W, ± 10%	Allen Bradley
R404	045-682	Resistor, Fixed, 220ohm, ½W, ± 10%	Allen Bradley
R405	045-777	Resistor, Fixed, 39Kohm, ½W, ± 10%	Allen Bradley
R406	045-724	Resistor, Fixed, 2.2Kohm, ½W, ± 10%	Allen Bradley
R407	045-724	Resistor, Fixed, 2.2Kohm, ½W, ± 10%	Allen Bradley
R408		Factory selected value	
R409	045-724	Resistor, Fixed, 2.2Kohm, ½W, ± 10%	Allen Bradley
R410		Not used	
R411	045-731	Resistor, Fixed, 3.3Kohm, ½W, ± 10%	Allen Bradley
R412	045-602	Resistor, Fixed, 2.7ohm, ½W, ± 10%	Allen Bradley
R413	045-668	Resistor, Fixed, 100ohm, ½W, ± 10%	Allen Bradley
R414	045-682	Resistor, Fixed, 220ohm, ½W, ± 10%	Allen Bradley
R415	045-763	Resistor, Fixed, 18Kohm, ½W, ± 10%	Allen Bradley
R416	045-724	Resistor, Fixed, 2.2Kohm, ½W, ± 10%	Allen Bradley
R417	045-724	Resistor, Fixed, 2.2Kohm, ½W, ± 10%	Allen Bradley
R418		Not used	
R419	045-714	Resistor, Fixed, 1.2Kohm, ½W, ± 10%	Allen Bradley
R420		Not used	

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
R421		Not used	
R422	045-602	Resistor, Fixed, 2.7ohm, ¼W, ± 10%	Allen Bradley
R423	045-668	Resistor, Fixed, 100ohm, ¼W, ± 10%	Allen Bradley
R424	045-686	Resistor, Fixed, 270ohm, ¼W, ± 10%	Allen Bradley
R425	045-794	Resistor, Fixed, 100Kohm, ¼W, ± 10%	Allen Bradley
R426	045-703	Resistor, Fixed, 680ohm, ¼W, ± 10%	Allen Bradley
R427	046-410	Resistor, Fixed, 1Kohm, 1W, ± 10%	Allen Bradley
R428	045-763	Resistor, Fixed, 18Kohm, ¼W, ± 10%	Allen Bradley
R429	046-417	Resistor, Fixed, 1.5Kohm, 1W, ± 10%	Allen Bradley
R430	045-668	Resistor. Fixed, 100ohm, ¼W, ± 10%	Allen Bradley
R431	046-417	Resistor, Fixed, 1.5Kohm, 1W, ± 10%	Allen Bradley
R432	047-083	Resistor, Precision, 50ohm, ½W, ± 1%	Texscan Corporation
R433	045-710	Resistor, Fixed, 1Kohm, ¼W, ± 10%	Allen Bradley
R434	045-626	Resistor, Fixed, 10ohm, ¼W, ± 10%	Allen Bradley
R435	045-707	Resistor, Fixed, 820ohm, ¼W, ± 10%	Allen Bradley
R436	045-703	Resistor, Fixed, 680ohm, ¼W, ± 10%	Allen Bradley
R451	045-766	Resistor, Fixed, 22Kohm, ¼W, ± 10%	Allen Bradley
R452	045-749	Resistor, Fixed, 8.2Kohm, ¼W, ± 10%	Allen Bradley
R453	045-749	Resistor, Fixed, 8.2Kohm, ¼W, ± 10%	Allen Bradley
R454	045-749	Resistor, Fixed, 8.2Kohm, ¼W, ± 10%	Allen Bradley
R455	045-766	Resistor, Fixed, 22Kohm, ¼W, ± 10%	Allen Bradley
R456	048-036	Resistor, Variable, 5Kohm	Texscan Corporation
R457,S451	048-059	Resistor, Variable, 10Kohm, 4P-2Pos.	Texscan Corporation
R458	048-034	Resistor, Variable, 250ohm	Texscan Corporation
R459	045-703	Resistor, Fixed, 680ohm, ¼W, ± 10%	Allen Bradley
R460		Not used	
R461	045-752	Resistor, Fixed, 10Kohm, ¼W, ± 10%	Allen Bradley
R462	046-075	Resistor, Fixed, 150ohm, ½W, ± 10%	Allen Bradley
R463		Factory selected value	
R501	045-738	Resistor, Fixed, 4.7Kohm, ¼W, ± 10%	Allen Bradley
R502	045-749	Resistor, Fixed, 8.2Kohm, ¼W, ± 10%	Allen Bradley
R503	045-703	Resistor, Fixed, 680ohm, ¼W, ± 10%	Allen Bradley
R504	046-082	Resistor, Fixed, 220ohm, ½W, ± 10%	Allen Bradley
R505	046-082	Resistor, Fixed, 220ohm, ½W, ± 10%	Allen Bradley
R506	045-682	Resistor, Fixed, 220ohm, ¼W, ± 10%	Allen Bradley
R507	045-724	Resistor, Fixed, 2.2Kohm, ¼W, ± 10%	Allen Bradley
R508	045-749	Resistor, Fixed, 8.2Kohm, ¼W, ± 10%	Allen Bradley
R509	045-703	Resistor, Fixed, 680ohm, ¼W, ± 10%	Allen Bradley

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
S1	057-004	Switch, 1P2T	Cutler Hammer 8280K16
S301	057-002	Switch, Rocker	Stackpole RS-50-FE
S302	057-002	Switch, Rocker	Stackpole RS-50-FE
S303	057-002	Switch, Rocker	Stackpole RS-50-FE
S304	057-002	Switch, Rocker	Stackpole RS-50-FE
S305	057-002	Switch, Rocker	Stackpole RS-50-FE
S306	057-002	Switch, Rocker	Stackpole RS-50-FE
S307	057-002	Switch, Rocker	Stackpole RS-50-FE
S308	057-002	Switch, Rocker	Stackpole RS-50-FE
T1	B061-009	Transformer, Power	American Magnetics 3441
Z401	A200-047	Attenuator, SA-50Mod.	Texscan Corporation
Z501	A204-059	Filter	Texscan Corporation
Z601	A200-004	Termination	Texscan Corporation
Z602	A200-004	Termination	Texscan Corporation

WARRANTY

All our products are warranted against defective materials and workmanship for one year from date of shipment. Texscan will repair or replace products (except tubes and transistors) which are found to be defective during the one-year warranty period. This warranty does not apply to consequential damage.

CLAIM FOR DAMAGE IN SHIPMENT

Your instrument should be inspected and tested as soon as it is received. If the instrument is damaged in any way or fails to operate properly, file a claim with the carrier, or if insured separately, with the insurance company.

CHANGE IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time, and to furnish merchandise in accordance with current specifications without incurring any liability to modify equipment previously sold.

SHIPPING

On receipt of shipping authorization from the factory, forward the instrument prepaid. Care should be taken in packing the instrument and identifying it by model number and serial number.